New hydroxyapatite- and selenium-based nanoformulations as potential antimicrobial tools for orthopedic implants

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Antimicrobial Resistance (AMR) is a phenomenon dramatically spreading among pathogens, resulting in the inefficacy of most available antibiotics worldwide and posing a serious threat to human health and economics, as only in the European Union AMR costs ca. 1.5 billion EUR and causes ca. 25,000 deaths per year [1-3]. An emerging and pressing AMR-related issue is represented by the severe and exponential diffusion of orthopedic-implant infections, as billions of these devices are used worldwide [4]. A large portion of these implants is colonized by AMR pathogens after or even before surgery, causing chronic infections, prosthesis failure, pain, immobility, amputation, and even mortality [4]. Thus, designing sound and successful antimicrobial formulations unlikely to determine AMR phenomena is of utmost importance to avoid risks for human health.

Hydroxyapatite (HA) is largely exploited to coat orthopedic implants, as it is the principal component of mammalian bones and an ideal carrier for drug delivery and controlled release [6-7]. Currently, metal ions or nanomaterials (NMs) are investigated as antimicrobial alternatives, yet several concerns regarding their cyto- and geno-toxic effects on humans, and the rapid escalation of metal-AMR, have risen [6]. Hence, antimicrobial solutions based on less diffuse yet essential elements, such as Selenium (Se), are gaining scientific interest [6].

In the present study, innovative, eco- and bio-compatible HA nanowires (HANWs) were synthesized through a solvothermal process [8]. These NWs were subsequently loaded with SeNPs, which were obtained by using the amino acid L-cysteine as reducing and capping agents [9], to develop a feasible starting point to generate new antimicrobial coatings for orthopedic implants.

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